An Experimental Study on Discretionary Environmental Enforcement

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1. Introduction

Enforcement of laws and enforcing institutions are the most crucial elements of any regulatory policy design and should be taken into consideration when formulating policies for promoting social welfare. In the last decade, the enforcement toolbox of U.S. environmental regulators and institutions has been harshly criticized [see, for example, Abbot, 2005] for having a too large amount of discretion, administrative or investigative, in the hands of the Environmental Protection Agency (from now on, EPA), and prosecutorial discretion in the hands of the Department of Justice (from now on, DOJ).

The present work is motivated by the observation that the enforcement of environmental laws is characterized by the fact that some violators are sentenced at criminal level while some others, who have in substance committed the same crime, are not punished or are sanctioned with a purely administrative or civil fine [Barrett, 1992; Cory and Germani, 2002; Babbit et. al., 2004]. This, in turn, raises the question of the effectiveness in terms of firms’ compliance of such enforcement system characterized by a high level of discretion at both administrative and civil/criminal level.

In trying to address this issue, Germani and Scaramozzino [2007] (from now on, G&S) in a recent study modeled the enforcement problem as a game where the firm’s behaviour is influenced by the course of actions discretionally implemented by both the EPA and the DOJ, and they find out that the role of the DOJ is irrelevant as it does not affect the level of compliance by the firms. Departing from the theoretical model set up by G&S, we try to empirically validate their result by means of a laboratory experiment. The paper is organized as follows. In the next section, some key aspects of the main literature on environmental enforcement are provided.
Section 3 outlines the experimental model and describes the design of the performed experiment. Section 4 presents the preliminary findings. Section 5 offers some concluding remarks.

2. Some key references in the literature

The vast theoretical literature on enforcement [see for all, Polinsky and Shavell, 1984, 2000; Posner, 1985, 2003; Shavell, 1993, 2003; Stigler, 1970; Garoupa, 1997, 2001, 2004] shows the fundamental importance of acting upon socially efficient enforcement strategies. As stated by Veljanovski [1984], “it is legal rules and their enforcement that together shape the incentives and deterrents that attempt to alter the behaviour of those regulated and induce compliance with the law”. Also, Ayres and Braithwaite [1992] in their seminal work, strongly underline how “the trick of successful regulation is to establish a synergy between punishment and persuasion”; as it is well known, the basic prescription of enforcement theory is that potential violators behave according to both the probability of being detected and the severity of the sanction. This implies that deterrence may be improved either by raising the sanction, by increasing the expenditures on enforcement in order to raise the likelihood that the violator is captured,\(^1\) or again by changing the legal rules in order to increase the probability of detection [Cohen, 1998]. From an economic perspective, perfect compliance is neither possible nor desirable; since monitoring and enforcement activities are costly for the regulatory authority, the socially optimal level of enforcement has to be found at the point where the costs of law enforcement outweigh the benefits of harm prevention. This is a very crucial point and its importance is demonstrated by

\(^1\) In Becker’s model, the efficient level of crime is observable when the marginal cost of enforcement is equal to the marginal social benefit of crime reduced per unit of enforcement.
the fact that most of the law and economics literature has been focusing on how to best induce compliance at a lower enforcement cost.

Another key element of any regulatory policy is the choice of enforcement actions among those which are available to the relevant institutions (regulators and courts), ranging from administrative actions to civil litigations and criminal prosecutions. Arruñada and Casari [2007] analyze experimentally how different political and judicial institutions may fail to produce enforcement and thus determine market failures. They show that some alternative institutional arrangements may, on the one hand, produce different enforcement results and, on the other hand, provide decision makers with different incentive functions, by encouraging or discouraging enforcement actions.

Unfortunately, the empirical literature on the determinants of firms’ environmental compliance is still very limited, and further investigation into how environmental regulators can influence firms’ compliance behaviour in the real world is needed in order to better understand not only what kinds of enforcement actions are more effective in deterring noncompliance, but also in order to learn how to design and implement more efficient environmental regulations.

More empirical research, moreover, is required with regard to authorities’ discretion in their enforcement of environmental regulation in order to better understand how firms perceive their relationship with environmental regulators and how they react to their enforcement strategies. The need for further empirical analysis is, therefore, equally essential for regulators in order to assist them in undertaking the mix of enforcement approaches more suitable to attain the highest level of compliance by the firms.

To our knowledge, this work is the first attempt to offer an empirical validation on the efficacy of a combined use of administrative and civil/criminal enforcement approaches. While
the theoretical literature on the optimal use of sanctions is certainly extensive and well-known [Brickey 1996, 1998, 2000], the main obstacle in carrying out empirical studies on environmental enforcement policies continues to be the lack of systematic data. Most of the existing experimental literature is on tax compliance (Alm and McKee, 1998) and analyses the impact on individual behaviour of different policy changes, such as tax amnesties or changes in penalty rates. In our work, we concentrate on the implications in terms of firms’ environmental compliance deriving by the use of administrative and civil or criminal enforcement procedures. This paper, in fact, will attempt to bridge this gap in the literature, providing some new empirical insight by means of a laboratory experiment.

3. The experimental model

As already discussed, our experiment is grounded on the model proposed by G&S where two games are played out: first, the authors consider the game between the firm and the EPA, where the firm can choose whether to comply with environmental regulations or not, by assessing the costs and benefits of compliance versus pollution. The EPA, not knowing the strategy chosen by the firm, must decide whether to carry out inspections or not. Then, the authors consider a more complex game, where the EPA can serve a notice of violation to the firm if the latter is found to be non-compliant and the task of environmental control is subsequently taken up by the DOJ - which must choose between a civil and a criminal prosecution. Interestingly, the authors show that the probability of compliance is unaffected by the presence of the DOJ.

This finding is rather interesting as it shows that firms are deterred in their behaviours solely by EPA’s administrative sanctions. Hence, it suggests that the presence of DOJ is just a
cost for the society as it does not increase the probability of firms’ compliance with environmentally sound behaviours.

In this paper, we shall attempt to test this finding by means of two laboratory experiments, following a two-step procedure. In the first experiment, we estimate individuals’ utility functions through an experiment on choice data (henceforth referred to as *choices experiment*). Once estimated the utility functions subject by subject, we solve again the game retrieving the as if probability of the mixed strategy for each subject.

Subsequently, we will perform the second step, where we run a new experiment which will allow us to calculate the probability of compliance by letting subjects play two treatments which correspond to the two games proposed by G&S and described in section two above - i.e. the treatment without the DOJ and the treatment with the DOJ (henceforth referred to as *enforcement experiment*). We then, compare our theoretical results (i.e. those obtained using the estimated utility functions) with the experimental findings obtained in the second experiment.

We maintain that this procedure will allow us to obtain robust results, providing a generalization of the theoretical findings of G&S to a situation in which agents are not necessarily homogeneous and risk-neutral. In what follows, we shall describe in some more detail the two experimental sessions here presented.

### 3.1 Experimental Design

As mentioned above, we run two experiments, the fists one – a computerized experiment – was conducted at ESSE (Economia Sperimentale al Sud d’Europa) at the University of Bari; the second one – a *paper and pencil* experiment – was conducted at the University of Foggia without
monetary incentives. Participants were undergraduate students from different disciplines at the Universities of Bari and Foggia. The computerized experiment was programmed using the z-Tree software (Fischbacher, 2007).²

In the computerized experiment we first elicited subjects’ preferences towards risk, then we elicited subjects’ behaviour towards the enforcement game. In the paper and pencil experiment we concentrate only on the enforcement part.

3.1.1 Choice experiment

In the Choice experiment we collect data from a series of pairwise choice questions so as to estimate individual preference under risk. The pair-wise choice lotteries are presented as segmented circles on the subject’s computer screen. Subjects have to indicate whether they prefer the left lottery, or the right lottery. After pressing the corresponding key they have to confirm their choice by pressing the return key. If a pair-wise choice question is selected as reward the subject can simply play out the preferred lottery.

In the computerised experiment we elicited subjects’ preferences towards risk, using the 100 pairwise choice questions reported in Table 1.

In both experiments, amounts were denoted by ECU (Experimental Currency Unit), where 10 ECU = €1. In order to avoid portfolio-diversification effects, participants in the computerized experiment were paid according to one of their choice, randomly chosen among the 100 choices available. The whole procedure was carefully explained to all participants before starting the experiments.

² The program is available on request.
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3.1.2 Enforcement experiment

The enforcement experiment builds on the decision problems described in G&S and briefly introduced above. Specifically, following G&S, in our experiment we consider two games. In the first game, players acting as firms, play against the EPA (which is be played by the Nature). On the one hand, the firm chooses between complying or not; on the other hand, the EPA chooses whether to carry out inspections or not. If the firm complies, it has to sustain a cost. The EPA also has to incur a cost if it decides to carry out an inspection (see figure 1).

**Figure 1: Strategic game between firm and EPA in extensive form**

In the second game, the EPA can serve a notice of violation to the firm if the latter is found non-compliant and the task of environmental control is subsequently taken up by the DOJ (also played by the Nature) - which must then choose between a civil and a criminal prosecution (see figure 2).

Therefore, in the second game EPA’s exercise of discretion comes into play in two instances: first with regard to the decision of whether to investigate or not on the violation, and
then, in case it does decide to investigate, regarding whether to initiate an administrative, civil or criminal enforcement action.

Figure 2: Strategic game between firm, EPA and DOJ in extensive form

Moreover, if EPA decides to pursue a case civilly, it has two options: it may handle the matter internally or seek fines in a federal court. If the EPA decides to deal with the case administratively, then it shall issue a notice of violation ordering compliance and/or assigning a penalty to the violation. A notice of violation describes the violation and commands the violator

3 As noted by Firestone, administrative and civil judicial enforcement share many elements. The primary distinguishing characteristic is that with administrative enforcement, EPA typically functions as both the enforcer and the adjudicator. A judge or EPA, as appropriate, may impose a civil sanction in an environmental matter whenever a person has violated or is violating a law or a permit condition [see, e.g., 42 U.S.C. § 7413(a)(3) (2000)].
to stop the activity. At this point, the firm must decide again whether to be compliant or non-compliant. If it does not comply and if the case cannot be resolved at the administrative level, then the EPA will refer it to the Department of Justice for civil or criminal prosecution. At this stage, the DOJ can exercise its discretion whether to initiate a civil or a criminal proceeding.

We elicit subjects’ behaviour towards the enforcement game using the following 4 pairwise choice gambles (see figure 3).

![Figure 3: pairwise choice gambles for the enforcement experiment](image)

The pairwise choice gamble in the top-left corner represents the firm’s decision problem reported in figure 1. On the one hand, if the firm decides to *comply*, whatever will be the EPA action, she will get \( v_c \) (see the left gamble); on the other hand, if the firm decides to *not comply* her pay off will depend on the EPA action, more precisely she will get (with probability \( q \)) \( v_f \) if the EPA decided to inspect, and \( v \) otherwise (see the right gamble).

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4 The purpose of a notice of violation is to initiate corrective action that will stop the violation. To provide an incentive for continuing compliance, NOVs for the Clean Water Act may result in monetary penalties up to $27,500 per day, per violation, according to 33 U.S.C. 1319.
The pairwise choice gamble in the top-right corner represents one part of the firm decision problem reported in figure 2. More precisely, if the firm decides to *comply*, whatever will be the EPA action, she will get $v-c$ (see the left gamble); if the firm decides to *not comply* her pay off will depend on the EPA’s action, if the EPA decides to *not inspect* she will get (with probability $q$) $v$; if the EPA decides to *inspect* and the firm reacts to the EPA’s notice of violation by complying, then her payoff will be, independently by the DOJ decision, $v-c-c_1$ (see the right gamble).

The pairwise choice gamble in the bottom-left corner represents the remaining part of the firm decision problem reported in figure 2. If the firm decides to *comply*, whatever will be the EPA action, she will get $v-c$ (see the left gamble); if the firm decides to *not comply* and the EPA decides to *not inspect* the firm gets (with probability $q$) $v$; if the EPA decides to *inspect* and the polluting firm does not react to the EPA’s notice of violation by complying, then her payoff will be $v-c-f$ if the DOJ start a *civil* proceeding and $v-c-j$ if the DOJ starts a *criminal* proceeding (see the right gamble).

Finally, the pairwise choice gamble reported in the bottom-right corner represents a consistency test.

4. Preliminary findings

In this section we present some preliminary findings obtained running a pilot experiment on the G&S model. Out of the 51 subjects that took part to the experiment, two of them did not pass the consistency test discussed above. One of the two subjects displayed also an irrational behaviour in the second session of the experiment (i.e. when the DOJ was introduced).
Henceforth, we drop these two subjects from the database and conduct our analysis upon the remaining 49 observations.

As discussed in the experimental design section above, we preliminary tested the strategic game between the EPA and the firm, as showed in figure 4. Out of the 49 subjects considered, almost half of the sample decided to comply (24 subjects). We then compare this result with those obtained in the second session of the experiment in order to test the core finding of G&S - i.e. that the introduction of the DOJ does not affect the probability of compliance and, therefore, that the DOJ represents a net cost for the society.

**Figure 4: Subjects’ behaviour in the game between firm and EPA**

In the game played between firm, EPA and DOJ, as showed in figure 5, only 11 subjects complied with the environmental standard in the first move. This striking result would suggest that introducing the DOJ produces a sharp reduction in the rate of compliance. However, we can observe that out of the 38 subjects that decided to pollute, almost 45 per cent of them would switch to a non polluting behaviour once the EPA notifies the violation.
As set in the G&S model, we know that the probability of inspection (and, hence, of receiving a notice of violation) is $q = \frac{c}{c - c_i}$. So, under our experimental parameterization, this probability will be equal to 14.3 per cent. This implies that the EPA will start an inspection only in less than 15 cases out of 100 and, therefore, we can expect that less than 3 firms will switch to compliance after the EPA has decided whether to inspect or not.

All in all, this adds up to a total number of complying firms equal to 13.42, that is almost half of the firms that decided to comply if they play only with the EPA. Hence, we can conclude

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5 The exact value is 2.42.
that the introduction of the DOJ in the game reduces sharply the number of complying firms and, therefore, reduces the efficacy of the enforcement strategy.

In addition, we can calculate the threshold value of $q$ which would lead to an equilibrium in which the same number of firms would comply, in both games with and without the DOJ. This value is 0.69, implying that if the EPA would conduct an inspection with a probability greater than 69 per cent, a higher number of firms would eventually comply in a system which combines both EPA and DOJ.

Notice, that this threshold value of $q$ is compatible with a cost structure such that $c = 2.225 c_1$; i.e. a cost structure where the cost of compliance is more than twice as big as the additional compliance cost if the firm did not comply in the first instance. However, such cost structure is not coherent with the G&S assumptions on relative costs magnitude and, therefore, is never feasible. In turn, under the G&S parameterisation, our experimental findings suggest that the presence of the DOJ never increases the number of complying firms independently by the probability of inspection.

5. Some concluding remarks

In order to deter firms from committing environmental violations, every legal and institutional system has to decide the amount of resources (investigators, prosecutors, etc) to dedicate to the enforcement of environmental laws. The results obtained here allow us to draw some policy implications for an optimal law enforcement strategy. Criminal enforcement plays, obviously, a very important role in deterring pollution and has had, especially in the United States, a strong deterrent effect on polluters. However, one of the main criticisms of criminal
enforcement is that civil liability provides sufficient mechanisms of deterrence without involving expensive and protracted litigation costs [Hoffman, 1992]. Some critics have also noted that criminal enforcement does not lead to optimal deterrence because prosecutors are often accused of choosing cases arbitrarily based largely on political motivations [Lazarus, 1995].

Our findings may support these issues by showing that it is possible to protect the environment without having to recourse to criminal prosecutions and incarceration. Our results confirm, in fact, the outcomes obtained by G&S by supporting the argument that it is more efficient to let the EPA resolve the cases internally (administratively) rather than refer them to the Department of Justice for civil or criminal prosecution. From our experimental validation, it emerges that the intervention of the DOJ acts merely as an additional enforcement cost, which in turn, reduces the probability of conducting inspections by the EPA without affecting the probability of firm’s compliance. This suggests that enhancing criminal enforcement programs would not necessarily strengthen deterrence since criminal fines might not be able to give polluters the adequate incentives to the prevention of environmental crimes; criminal enforcement may, indeed, reduce the effectiveness of enforcement policies.

References


